

# THE GENUS *HYDROPSYCHE* PICTET, 1834 ON ISLANDS IN THE WEST PACIFIC REGION AND DESCRIPTION OF NEW SPECIES (TRICHOPTERA: HYDROPSYCHIDAE)

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Species of the genus *Hydropsyche* are largely distributed over the islands of the West Pacific. They are grouped into 4 species groups on the basis of male genitalic characters. The hitherto known species of the 4 groups are listed, and the distributional area of the groups is demonstrated. Among the 57 cited species 16 are newly described: *H. germanorum* sp. n., *H. staphylostirpis* sp. n., *H. taiwanensis* sp. n., *H. vialigni* sp. n., *H. initiana* sp. n., *H. malickyi* sp. n., *H. ambonensis* sp. n., *H. seramensis* sp. n., *H. palawanensis* sp. n., *H. gemellata* sp. n., *H. salki* sp. n., *H. sirimauna* sp. n., *H. suppleta* sp. n., *H. naumanni* sp. n., *H. sulana* sp. n., *H. bacanensis* sp. n. Correspondence: Dr. W. Mey, Museum für Naturkunde, Humboldt-Universität Berlin, Invalidenstr. 43, D-10115 Berlin, Germany.

Key words. – Taxonomy; new species; biogeography; SE Asia; West Pacific Island; Sundaland; *Hydropsyche*; species groups; Hydropsychidae; Trichoptera.

The species of *Hydropsyche* Pictet, 1834 show an interesting rate of endemism and speciation in the islands between Southeast Asia (= SE Asia) and Australia. All of the larger islands have a number of *Hydropsyche* endemics. By contrast, there are no species with a wide distribution over the entire region or with a range through several islands or island groups. Previous records of wide distribution areas for some species proved to be based on the misidentification of some specimens, e.g. *H. hobbyi* Mosely, 1951 described from Borneo and New Guinea in Mosely (1951), corrected by Kimmings (1962), and *H. bryanti* Banks, 1939 recorded from Sumatra, Java and Sumba in Ulmer (1951), corrected in Mey (1998). The high degree of endemism of *Hydropsyche* observed in the West Pacific Region suggests the existence of further, still unknown species on the islands which have not yet been sampled for caddisflies. It is to be expected that Halmahera, Seram, Obi, Sula, Buru, the Lesser Sunda Islands and especially New Guinea will have two to four additional *Hydropsyche* species each. Furthermore, the relatively better investigated Greater Sunda Islands, Sulawesi, the Philippines and Taiwan have diverse caddisfly faunas, which are by no means adequately surveyed.

Unknown *Hydropsyche* species are still to be found in these larger islands and archipelagos.

With this background it is clear, that we have not yet reached the advanced level of faunistic research, which is the prerequisite for any serious discussion of the origin, dispersal or diversity pattern of the genus in the West Pacific Region. In addition, the phylogenetic relationships within *Hydropsyche* have been studied only partially (e.g. Malicky 1977, Mey 1996, Nimmo 1987, Ross 1944). Even the concept of *Hydropsyche* and its probable sistergroup is a matter of much debate (Bueno-Soria 1984, Flint & Bueno-Soria 1987, McFarlane 1976, Nielsen 1981, Ross & Unzicker 1977, Scheffer 1996, Scheffer et al. 1986, Schmid 1979, Schuster 1984, Tanida 1986, Tian & Li 1987). Without a detailed phylogenetic analysis and without adequate knowledge of the existing species and their geographic distributions, it is not possible to use the genus as an example for reconstructing the evolutionary history of the region and its biota. However, the data on *Hydropsyche* so far accumulated are quite sufficient to recognise that the group is an extremely promising candidate for elucidating dispersal or vicariance patterns and tracing them further into the past.

The purpose of this paper is to contribute to the improvement of the faunistic database of the genus. It presents the first records of *Hydropsyche* species from the Moluccas and from Palawan. In addition, a list of all described taxa and their distribution has been compiled. It is thought that this will be the starting point for an enhanced faunistic research in the region, which should subsequently lead to a biogeographic analysis of the genus.

## METHODS

Material examined in this study was obtained from several sources. Most of the caddisfly specimens were collected with a mercury-vapour light source by several entomologists. A portable generator was used as the power unit. The majority of specimens is preserved in 75% ethanol. Examination and drawing of male genitalia was done after the entire abdomen had been cleared in boiling KOH, washed and replaced in ethanol. Illustrations were prepared with the aid of a Wild drawing equipment on a Wild M8 stereo-microscope.

The shape of the genitalic structures in lateral, ventral and dorsal view varies between species. They provide clear characters for species separation and recognition, which are best appreciated by comparing the figures, rather than by long descriptions or written keys. In contrast to the genitalia, the external characters (e.g. coloration, mouth parts, wing venation) of the species are extremely uniform and can not be used in the identification of species.

## DELIMITATION OF THE STUDY AREA

This study concerns the West Pacific region, which covers most of the islands between continental SE Asia and North Australia. Within this vast area the following countries are situated: Indonesia, West Malaysia (Sarawak, Sabah), Brunei, Philippines, Taiwan, Papua New Guinea, Solomon Islands. Hainan is excluded from the present study.

## THE SPECIES-GROUPS OF HYDROPSYCHE IN THE WEST PACIFIC

The *Hydropsyche* species of SE Asia and Australia have not attracted much interest, probably because they are not frequently reported in the literature nor are there many people working with them. Even in discussions of the phylogeny of the genus on a world-wide scale, the South East Asian and West Pacific species have been disregarded. However, the region has at least 4 distinct species groups, which have no further representatives elsewhere (*H. pluvialis* group, *H. formosana* group, *H. hamifera* group, *H. buergersi*

group). Members of the *H. pluvialis* group were not recorded from the Sunda Islands up to now. In addition, the regions bears a number of isolated species, which cannot be assigned to any of the defined species groups (e. g. *H. vasoumittra* Schmid, 1961). A fifth group has a subgeneric name of its own: *Ceratopsyche* Ross & Unzicker, 1977. I do not use this name for the moment, because it implies also a subgeneric level for the other groups. As a consequence, three new genus group names would have to be proposed now or later. The taxonomic treatment of the groups, however, is not the subject of the present article. New names should be proposed in accordance with the results of a sound phylogenetic study. Before such an analysis is published I prefer to group related species into species-groups. Although the groups are informal entities I follow common nomenclatorial practice and use group-names based on the first described species in each group. The definitions of the groups are based entirely on characters of the male genitalic apparatus.

### 1. *Hydropsyche newae* group

*Ceratopsyche* Ross & Unzicker, 1977: 305.  
*morosa* group, Scheffer & Wiggins 1986: 2.  
*silfvenii* group, Malicky 1977: 2.  
*penicillata* group, Schmid 1965: 137.

### Diagnosis

Phallosome sinuate, with the genital opening on the dorsal side between paired phallosomal sclerites; apex of phallosome extending beyond phallosomal sclerites, partially membranous and with spicules or with membranous lobes; dorsolateral membrane simple or complex; 10th segment with two apical appendages (= appendices digitiformis).

### Distribution

Holarctic and Oriental biogeographic region (fig. 1).

### List of species

<i>H. annulata</i> (Ulmer, 1905)	Java
<i>H. germanorum</i> sp. n.	Sumatra
<i>H. orbiculata</i> Ulmer, 1911	Taiwan
<i>H. staphylostirpis</i> sp. n.	Lombok
<i>H. taiwanensis</i> sp. n.	Taiwan
<i>H. vialignii</i> sp. n.	Sumatra

### 2. *Hydropsyche hamifera* group

*bryanti-celebes-annulata* group, auctorum  
*javanica* group, Mey 1990: 414

### Diagnosis

Basis of phallosome simply bent; phallosomal scler-



Fig. 1. Distributional area of the *Hydropsyche newae* group. – The map shows the distributional limits in Asia. The entire area of the group includes Northern and Middle Europe and North America.

Fig. 2. Distributional area of the *Hydropsyche hamifera* group.

rites on dorsal side of phallosome fused, forming a ring with a shorter or longer elongation on the ventral side, forming a phallosomal tongue, which gives the apex of the phallosome a trifurcate appearance; dorsolateral membrane with 1 - 3 appendages; 10th segment with apical appendages and a pair of small processes on a flat dorsal side.

### Distribution

Sunda Islands, Philippines, Wallacea biogeographic region, New Guinea (fig. 2).

### List of species

<i>H. ambonensis</i> sp. n.	Ambon
<i>H. bacanensis</i> sp. n.	Bacan
<i>H. bifurcata</i> Mey, 1990	Luzon
<i>H. brueckmanni</i> Mey, 1995	Luzon
<i>H. buenafei</i> Mey, 1998	Negros
<i>H. calawiti</i> Mey, 1995	Mindoro
<i>H. cebuensis</i> Mey, 1998	Cebu, Negros
<i>H. celebensis</i> Ulmer, 1951	Sulawesi
<i>H. davisi</i> Mey, 1998	Negros, Mindanao
<i>H. declinans</i> Mey, 1990	Luzon
<i>H. excelsa</i> Mey, 1990	Luzon
<i>H. fascelina</i> Mey, 1998	Mindanao
<i>H. faurai</i> Navás, 1925	Luzon
<i>H. forcipata</i> Ulmer, 1930	Mindanao
<i>H. gemellata</i> sp. n.	Sulawesi

<i>H. gerostizai</i> Mey, 1998	Negros
<i>H. hamifera</i> Ulmer, 1905	Sulawesi
<i>H. hobbyi</i> Mosely, 1951	Borneo
<i>H. initiana</i> sp. n.	Sumatra
<i>H. isolata</i> Banks, 1931	Borneo
<i>H. javanica</i> Ulmer, 1905	Java
<i>H. luzonica</i> Mey, 1990	Luzon
<i>H. malickyi</i> sp. n.	Sumatra
<i>H. mindanensis</i> Mey, 1998	Mindanao
<i>H. mindorensis</i> Mey, 1995	Mindoro
<i>H. moseleyi</i> Kimmins, 1962	New Guinea
<i>H. muelleri</i> Mey, 1998	Mindanao
<i>H. naumanni</i> sp. n.	Sulawesi
<i>H. negrosensis</i> Mey, 1998	Negros
<i>H. palawanensis</i> sp. n.	Palawan
<i>H. rizali</i> Banks, 1937	Mindanao
<i>H. salki</i> sp. n.	Sulawesi, Moluccas
<i>H. saranganica</i> Ulmer, 1951	Java
<i>H. schintlmeisteri</i> Mey, 1990	Mindanao
<i>H. secundaria</i> Mey, 1998	Mindanao
<i>H. seramensis</i> sp. n.	Seram
<i>H. sirimauna</i> sp. n.	Ambon, Seram
<i>H. sulana</i> sp. n.	Sula
<i>H. suppleta</i> sp. n.	Ambon, Seram
<i>H. unitaria</i> Mey, 1990	Luzon
<i>H. villica</i> Mey, 1990	Luzon
<i>H. sp. n.</i> (Mey, in press)	Talud.

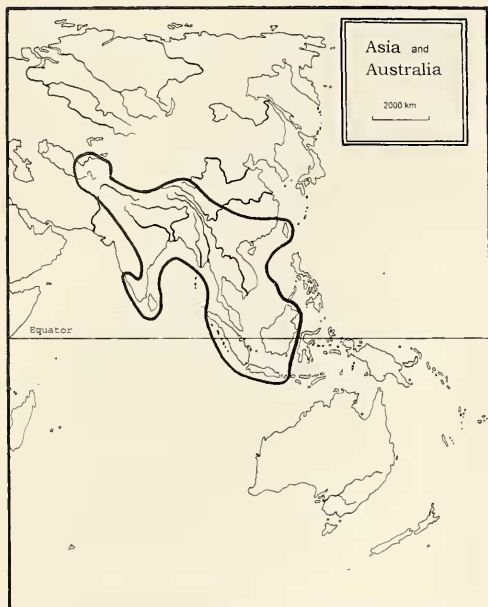


Fig. 3. Distributional area of the *Hydropsyche formosana* group.

### 3. *Hydropsyche formosana* group

*Mexipsyche* Ross & Unzicker, 1977: 305-306, sensu Tian & Li 1987: 125-126.

#### Diagnosis

Basis of phallosome simply bent; phallosomal sclerites vestigial or lost; bifid apex of phallosome membranous on dorsal side, sclerotized ventrally and with one or two keels; lateral sides of phallosome with a pair of proximally produced appendages; endophallus nearly as long as phallosome; segment 9 narrowed; segment 10 with apical appendages.

#### Distribution

Oriental biogeographic region (fig. 3).

#### List of species

<i>H. bryanti</i> Banks, 1939	Java, Sumatra
<i>H. banksi</i> Kimmins, 1955	Borneo
<i>H. doctersi</i> Ulmer, 1951	Java
<i>H. formosana</i> Ulmer, 1911	Taiwan, Malaysia
<i>H. irroratella</i> Ulmer, 1951	Java
<i>H. sp. n.</i> (Mey, in press)	Lombok
<i>H. sp. n.</i> (Mey, in press)	Sumatra
<i>H. sp. n.</i> (Mey, in press)	Borneo.



Fig. 4. Distribution of the *Hydropsyche buergersi* group.

### 4. *Hydropsyche buergersi* group

#### Diagnosis

Basis of phallosome simply bent; phallosomal sclerites small, situated at the tip of phallosome between a pair of sclerotized, large valves; dorsolateral membrane lacking; phallicata with a membranous area on the ventral side, just below the phallosomal sclerites; segment 9 of usual size; segment 10 with short apical appendages.

#### Distribution

Philippines, New Guinea, Solomon Islands (fig. 4).

#### List of species

<i>H. buergersi</i> Ulmer, 1915	New Guinea
<i>H. flynni</i> Korboot, 1964	New Guinea
<i>H. nasuta</i> Ulmer, 1930	Mindanao
<i>H. tapena</i> Kimmins, 1957	Guadalcanal.

The *buergersi* group is established here to summarise 3 species from New Guinea and one Philippine species. They do not belong to any of the aforementioned groups. Interestingly, they show affinities to some species of continental South East Asia, e.g. *H. adonis* (Malicky, 1996), *H. harpagofalcata* Mey, 1995 and *H. napaea* Mey, 1996. The diagnosis of the group is tentative, however. The type of *H. buergersi* Ulmer, 1915 was deposited in the Zoological Mu-

seum Berlin, but could not be found again. Neboiss (1986: 115) reproduced the original drawings. A re-description of *H. buergersi* Ulmer, 1915 together with collecting efforts to obtain new material of related species are necessary to provide more arguments for the monophyly and validity of the group.

### 5. Species incertae sedis

<i>H. ciosi</i> Navás, 1927	Mindanao
<i>H. testacea</i> Navás, 1933	New Guinea.

### DESCRIPTION OF NEW SPECIES

The descriptions are based exclusively on male genitalic characters. The female genitalia are very homogenous and can hardly be used for separating the species. In addition, most species occur sympatrically with other species of the genus, thus rendering the association of sexes doubtful.

Homologies of the phallic apparatus in *Hydropsyche* have been interpreted and named differently by various authors (e.g. Nielsen 1981, Ross & Unzicker 1977, Schmid 1979). The terminology used in this article follows Scheffer & Wiggins (1986: 4-5).

Most of the type material is deposited in the Museum für Naturkunde der Humboldt Universität Berlin (MNHb). Paratypes of some species are in coll. Malicky (Lunz am See). No explicit indication of paratype depository means storage in the MNHb.

### newae group

#### *Hydropsyche germanorum* sp. n. (figs. 5-6)

Type material. – Holotype ♂ (pinned), Indonesia, Sumatra, Sumatera Utara, Medan, Tiga Dolok, 13.ii.1995, leg. E. Diehl, in MNHb. – Paratypes: 5 ♂, same data as for holotype; 21 ♂, same locality, 22.ii.1995, leg. E. Diehl; 25 ♂, same locality, 20.i.1995, leg. E. Diehl; 5 ♂, Indonesia, Sumatra, Sumatera Aceh, Leuser N.P., Ketambe, 22.-24.i.1995, leg. A. Kallies; 3 ♂, 2 ♀, Sumatera Aceh, Calang, Kuala Don, Febr. 1996, leg. A. Kallies; 2 ♂, Indonesia, Sumatra, Sumatera Barat, 12 km E Padang, Mt. Talang, 1600m, 18.ix.1991, leg. A. Schintlmeister.

Description. – External characters: Length of forewing 6.5-7.3 mm. Head and thorax brown, with golden brown pilosity. Eyes black. Antennae yellow, with indistinct darker lines on the articulations of flagellomeres, tip of antennae brown, extending to apex

of forewing. Maxillary palpi brown, with last joint longer than the two preceding together. Labial palpi light brown. Legs yellowish. Forewings yellowish brown, with numerous pale spots dispersed over the wing, somewhat darkened towards outer wing margin.

Male genitalia (fig. 5-6): Segment 10 with short fingerlike appendages. Apical segment of inferior appendage (= harpago) broad, slightly bent and with an oblique tip. Phallosome sinuate, with short apical part. Phallosomal sclerites large, in vertical position on the dorsal side of phallosome. Dorsolateral membrane without appendages, but more proximal a small membranous window with a small spine. Apical membrane of phallosome with indistinct spicules, lateral membrane with a small lobe, directed distally.

Etymology. – The species is named in honour of the many German entomologists, who collected material of this species on several places in Sumatra.

Remarks. – The species is related to *H. annulata*, but differs by the vestigial spicules of the apical membrane, the lacking dorsolateral appendages and by the broad apical segments of the inferior appendages. Both species occur sympatrically in Padang, Sumatera Barat.

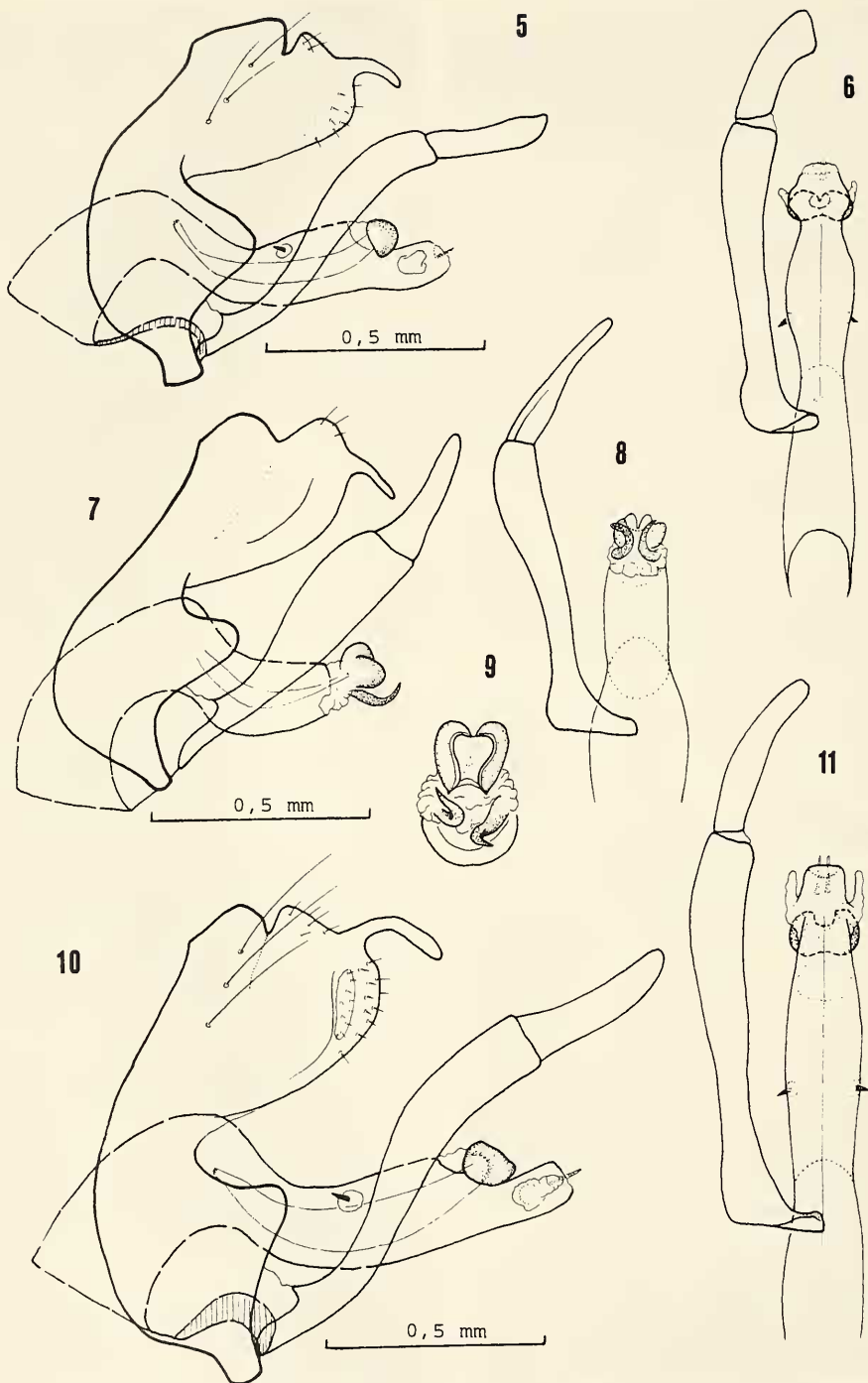
#### *Hydropsyche staphylostirpis* sp. n. (figs. 7-9)

Type material. – Holotype ♂ (pinned), Indonesia, Lombok, Narmada, 17.iii.1927, leg. Dr. [B.] Rensch, in MNHb. – Paratypes: 1 ♂, 1 ♀, same locality, 14.iii.1927.

Description. – External characters: Length of forewing 7 mm, wings golden brown, reticulate pattern weakly developed. Other characters as in *H. germanorum* sp. n.

Male genitalia (figs 7-9): Segment 9 shortened and slender in lateral view. Segment 10 with nearly straight apical appendages. Inferior appendages with a broad basal segment (= coxopodit) and an elongate second segment (= harpago). Phallosome sinuate, ending with the phallosomal sclerites. Dorsal membranous area without appendages, but extending ventrally to form a ventral membranous part beneath the phallosomal sclerites and equipped with two curved spines. Phallosomal sclerites excavated apicolaterally.

Remarks. – The new species is very remarkable by the reduced apical part of the phallosome and the pair of spines beneath the phallosomal sclerites. It is a quite isolated species in the newae group, but shows affinities to *H. annulata*.



Figs. 5-11. Male genitalia of *Hydropsyche* spp. – 5-6, *H. germanorum* sp. n., 5, lateral, 6, ventral; 7-9, *H. staphylostirpis* sp. n., 7, lateral, 8, ventral, 9, tip of phallosome, caudal; 10-11, *H. vialignii* sp. n., 10, lateral, 11, ventral.

***Hydropsyche vialigni* sp. n.**  
(figs. 10-11)

Type material. – Holotype ♂ (pinned), Indonesia, Sumatera Utara, Medan, Tiga Dolok (Holzweg 2), 22.ii.1995, leg. E. Diehl, in MNHB. – Paratypes: 2♂, same data as holotype.

Description. – External characters: Length of forewing 9-9.5 mm. Coloration and wing patterns as in *H. germanorum* sp. n.

Male genitalia (figs. 10-11): Segment 10 with curved apical appendages. Apical segment of inferior appendages rounded apically, not dilated. Phallosome sinuate, with short apical part behind phallosomal sclerites. Phallosomal sclerites large, on dorsal side of phallosome. Dorsolateral membrane without appendages, but more proximally a small membranous spot with a short spine. Apical membrane of phallosome with 2 protruding spicules, lateral membrane with small lobes, reaching tip of phallosome.

Remarks. – The new species is closely related to *H. germanorum* sp. n., but can be distinguished easily by the larger size of the species and by the unmodified second joint of the inferior appendages.

***Hydropsyche taiwanensis* sp. n.**  
(figs. 12-13)

Type material. – Holotype ♂ (in alcohol), Taiwan, Fushan Ilan, 25.xi.1995, leg. H. J. Wu, in MNHB. – Paratypes: 1♂, 2♀, same data as holotype; 1♂, Taiwan, Fushan Botanical Garden, 18.iv.1996, leg. S. H. Yen.

Description. – External characters: Length of forewings 8 mm. Other characters as in *H. germanorum* sp. n.

Male genitalia (figs. 12-13): Segment 9 and 10 not divided dorsally by a depression. Apical appendages of segment 10 broad, short and medially bent. Inferior appendages with a short first segment (= coxopodit), second segment (= harpago) elongate, with a rounded tip. Phallosome sinuate. Dorsolateral appendages with a short spine. Apical part of phallosome with long, membranous appendages, ending with a short spine. 2 small spikes in the apical membrane. Phallosomal sclerites large and broadly fused.

Remarks. – *H. taiwanensis* sp. n. is very similar to *H. orbiculata*. The species can be separated by the form and structure of the phallic apparatus.

***hamifera* group**

***Hydropsyche initiana* sp. n.**  
(figs. 14-16)

Type material. – Holotype ♂ (pinned), Indonesia, Sumatera Utara, Sipirok, 25.ii.1995, leg. E. Diehl, in MNHB. – Paratypes: 1♂ (pinned), same data as holotype; 10♂, Indonesia, Sumatera Utara, Medan, Tiga Dolok (Holzweg 2), 20.i.1995 (5♂), 13.ii.1995 (2♂), 22.ii.1995 (3♂), leg. E. Diehl.

Description. – External characters: Length of forewing 7-8 mm. Coloration and wing pattern as in *H. germanorum* sp. n.

Male genitalia (figs. 14-16): Segment 10 flat, without a carina. Segment 9 with apical appendages and with a pair of small dorsal processes fused at the base to form a Y-like structure. Apical segment (= harpago) of inferior appendages slender and pointed. Phallosome with a bifid membranous apical part, armed with a spine. Ventral tongue of phallosomal sclerites not reaching the tip of phallosome. Dorsolateral membrane with broad appendages, ending with a long spur each.

Remarks. – *H. initiana* sp. n. is related with *H. javanica* and *H. malickyi* sp. n. The shape of the 10th segment and the structure of the phallic apparatus clearly separates the species.

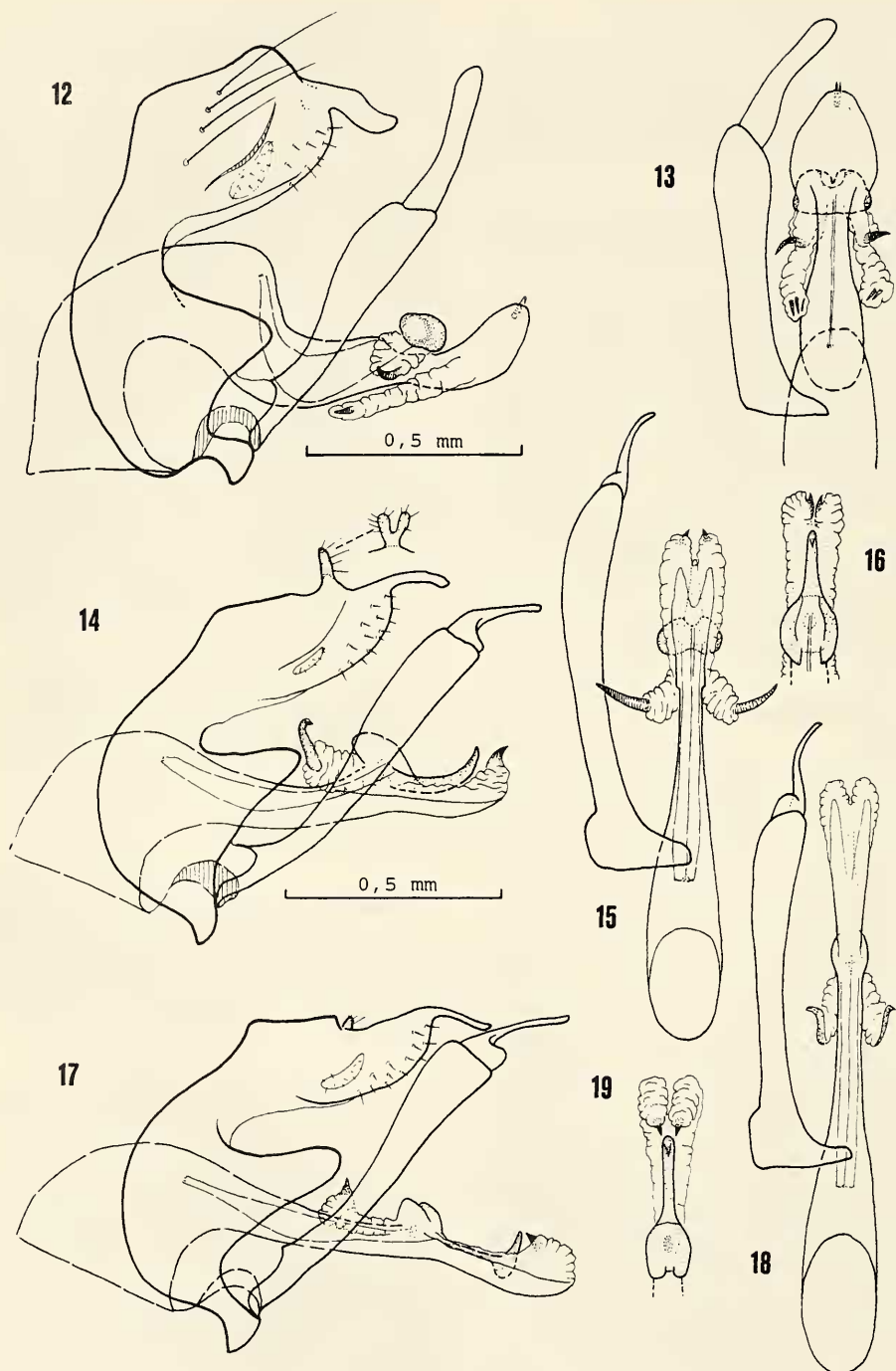
***Hydropsyche malickyi* sp. n.**  
(figs. 17-19)

Type material. – Holotype ♂ (pinned), Indonesia, Sumatera Utara, Medan, Tiga Dolok (Holzweg 2), 22.ii.1995, leg. E. Diehl, in MNHB. – Paratypes: 6♂, same data as holotype; 2♂, same locality, 13.ii.1995; 3♂, same locality, 20.i.1995, all leg. E. Diehl; 1♂, Sumatera Aceh, Tibbing Raja, 15.ii.1996, leg. A. Kallies.

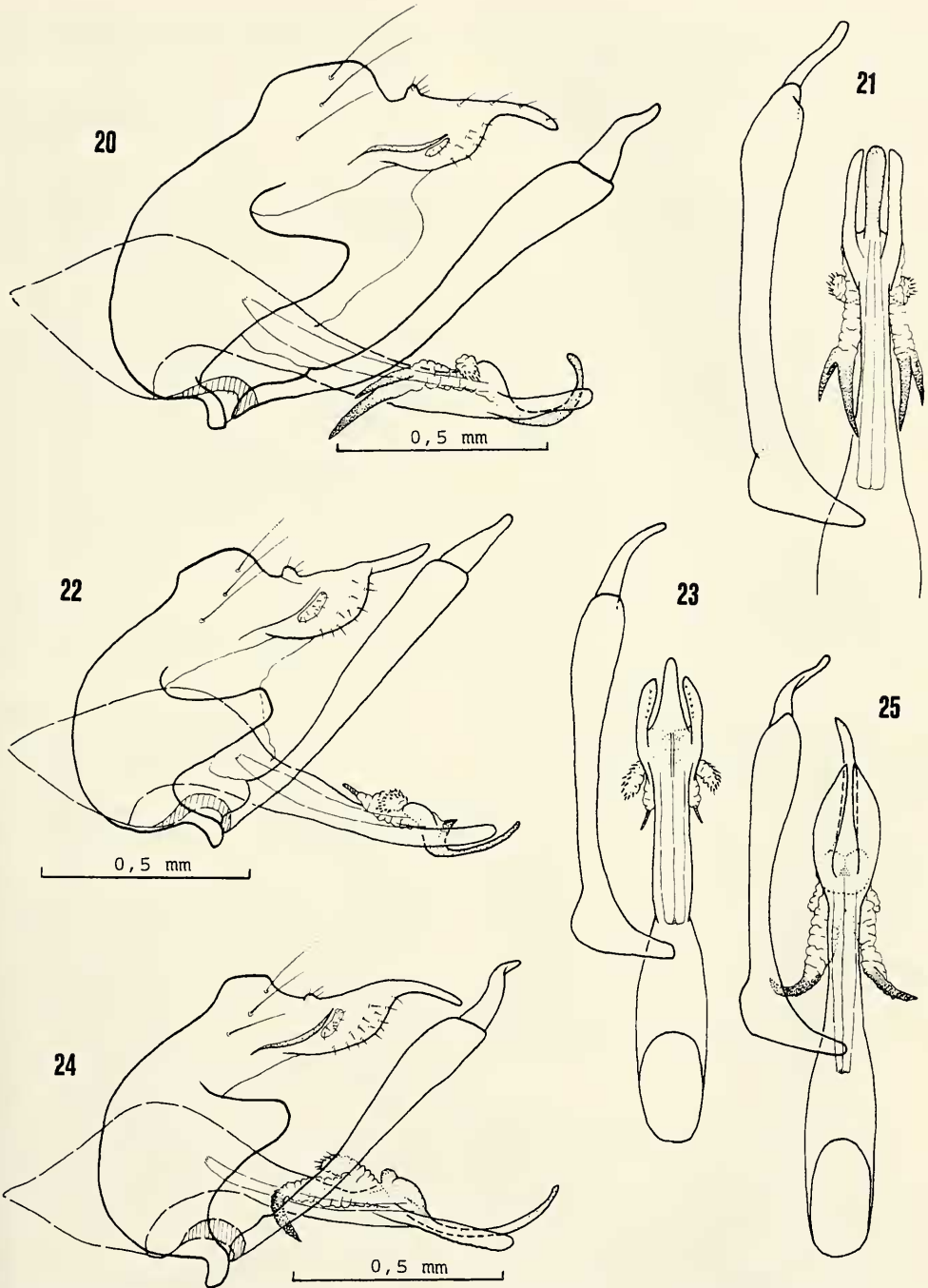
Description. – External characters: Length of forewing 8-8.5 mm. Coloration and wing pattern as in *H. germanorum* sp. n.

Male genitalia (figs. 17-19): Segment 10 with slender apical appendages and a pair of small dorsal processes. Apical segment of inferior appendages slender and ending with a seta. Base of phallosome broad, apical portion membranous dorsally and with two spines. Ventral tongue of phallosomal sclerites enlarged and hook-like apically, not reaching tip of phallosome. Dorsolateral membrane with broad appendages and a short spine.

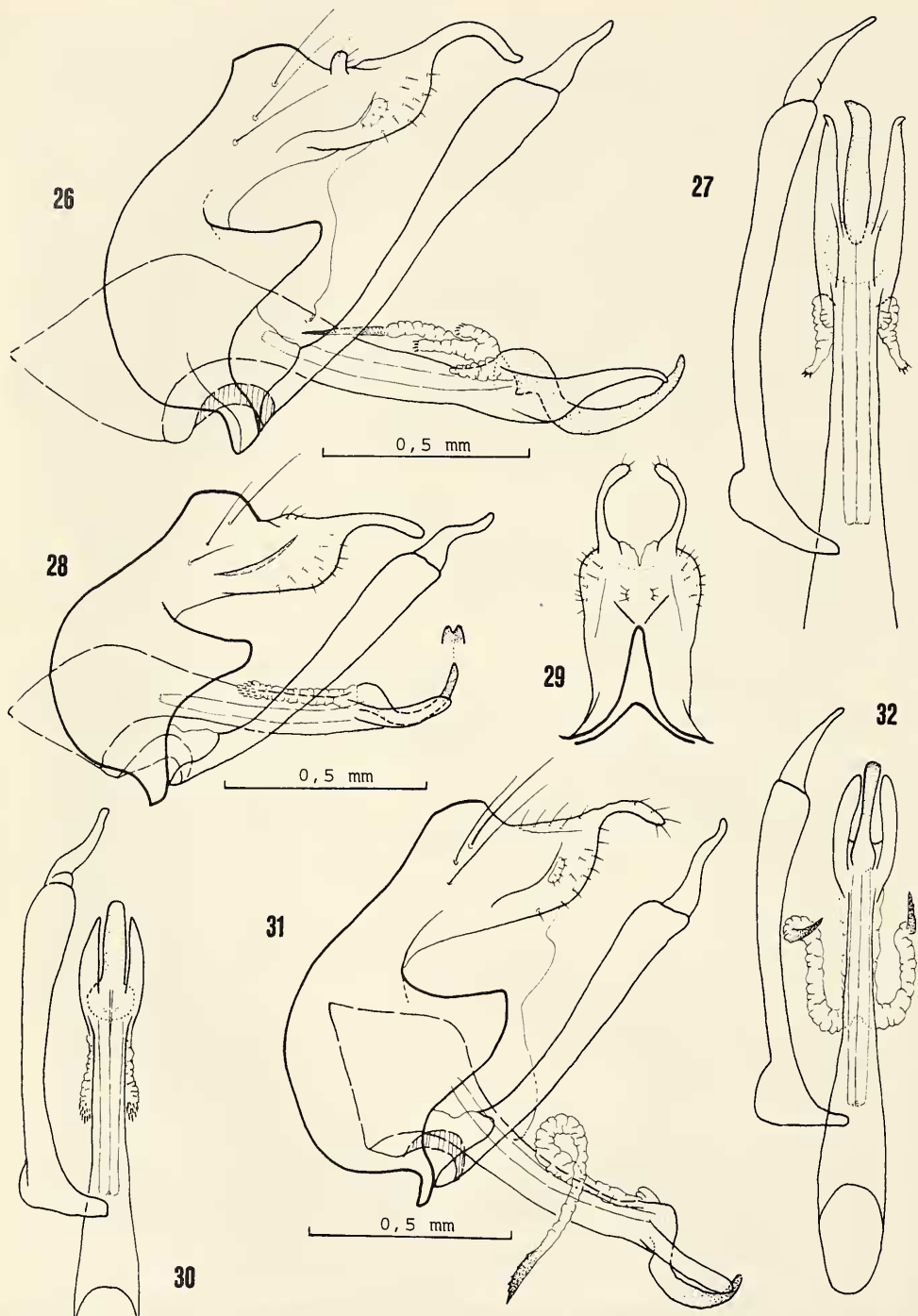
Etymology. – The new species is named in honour of Hans Malicky, who discovered and described a great deal of the caddisfly fauna of Sumatra.



Figs. 12-19. Male genitalia of *Hydropsyche* spp. – 12-13, *H. taiwanensis* sp. n., 12, lateral, 13, ventral; 14-16, *H. initiana* sp. n., 14, lateral, 15, ventral, 16, tip of phallosome, dorsal; 17-19, *H. malickyi* sp. n., 17, lateral, 18, ventral, 19, tip of phallosome, dorsal.



Figs. 20-25. Male genitalia of *Hydropsyche* spp. – 20-21, *H. ambonensis* sp. n., 20, lateral, 21, ventral; 22-23, *H. seramensis* sp. n., 22, lateral, 23, ventral; 24-25, *H. palawanensis* sp. n., 24, lateral, 25, ventral.



Figs. 26-32. Male genitalia of *Hydropsycha* spp. – 26-27, *H. gemellata* sp. n., 26, lateral, 27, ventral; 28-30, *H. salki* sp. n., 28, lateral, 29, dorsal, 30, ventral; 31-32, *H. sirimauna* sp. n., 31, lateral, 32, ventral.

Remarks. – The species is related to *H. javanica*. The main differences are exhibited by the long phalotheca and the shape of the phallotremal tongue.

***Hydropsyche ambonensis* sp. n.**  
(figs. 20-21)

Type material. – Holotype ♂ (in alcohol), Indonesia, Ambon, Gunung Sirimau, 500m, 23.vii.1995, leg. S. Naumann, in MNHB. – Paratypes: 1 ♂, same data as holotype; 3 ♂, Indonesia, Ambon, Katalai, 470m, 26.vii.1995, leg. S. Naumann.

Description. – External characters: As in *H. germanorum* sp. n., wing length 8 mm.

Male genitalia (figs. 20-21): Short apical appendages and short dorsal processes on segment 10. Harpago of inferior appendages much smaller than coxopodit, without peculiarities. Tip of phalotheca trifid. Tongue of phallotremal sclerites strongly curved and sclerotized. Dorsolateral membrane with two pairs of appendages, the smaller with minute spines apically, the longer ending with a large, bifurcate spur.

Remarks. – The new species is a close relative of *H. seramensis* sp. n. They differ in the form of the 10th segment and in the structure of the phallic apparatus.

***Hydropsyche seramensis* sp. n.**  
(figs. 22-23)

Type material. – Holotype ♂ (in alcohol), Indonesia, Seram, Piljana, Tule, 26.2.1995, leg. P. Salk, in MNHB. – Paratypes: 1 ♂, 1 ♀, same data as holotype.

Description. – External characters as in *H. germanorum* sp. n. Length of forewing 7.5 mm (♂)-8 mm (♀).

Male genitalia (fig. 22-23): Apical appendages of segment 10 straight, dorsal processes small. Second segment of inferior appendages short and simple. Phallotremal tongue longer than lateral tips of phalotheca, angulate at its base and with a small lateral teeth. Dorsolateral membrane with 2 pairs of appendages, the smaller with minute spines and the longer with an apical spur.

Remarks. – *H. seramensis* sp. n. is related to the preceding species. The form of the phallotremal tongue is unique within the group.

***Hydropsyche palawanensis* sp. n.**  
(figs. 24-25)

Type material. – Holotype ♂ (in alcohol), Philippines, Palawan, Puerto Princesa, Irawan river, 22.ii.1996, leg. J. Petersen, in MNHB. – Paratypes:

8 ♂, 9 ♀, same data as holotype (2 ♂ in coll. Malicky); 2 ♂, 1 ♀ (pinned), same locality, 24.-29.xi.1965, leg. D. Davis, in National Museum of Natural History, Washington (NMNH); 1 ♂ (pinned), Philippines, Palawan, Litsa, Amoyan Ck., 57 km N Puerto Princesa, 10.XII.1965, in NMNH.

Description. – External characters as in *H. germanorum* sp. n. Length of forewing 7-8 mm.

Male genitalia (figs. 24-25): Apical segment of inferior appendages slender and bent. Phallotremal tongue very long and slender, protruding the lateral sides of phalothecal tip with half of its length. Dorsolateral membrane with 2 pairs of appendages, the smaller with minute spines and the longer with a bent and serrate spur.

Remarks. – The new species is a close relative of *H. mindorensis* and *H. cebuensis*. The main differences can be found in the structures of the phalotheca.

***Hydropsyche gemellata* sp. n.**  
(figs. 26-27)

Type material. – Holotype ♂ (in alcohol), Indonesia, Sulawesi Selatan, Puncak Palopo, Tanah Toraja, 1300m, 19.viii.1995, leg. S. Naumann, in MNHB. – Paratypes: 2 ♂, same data as holotype.

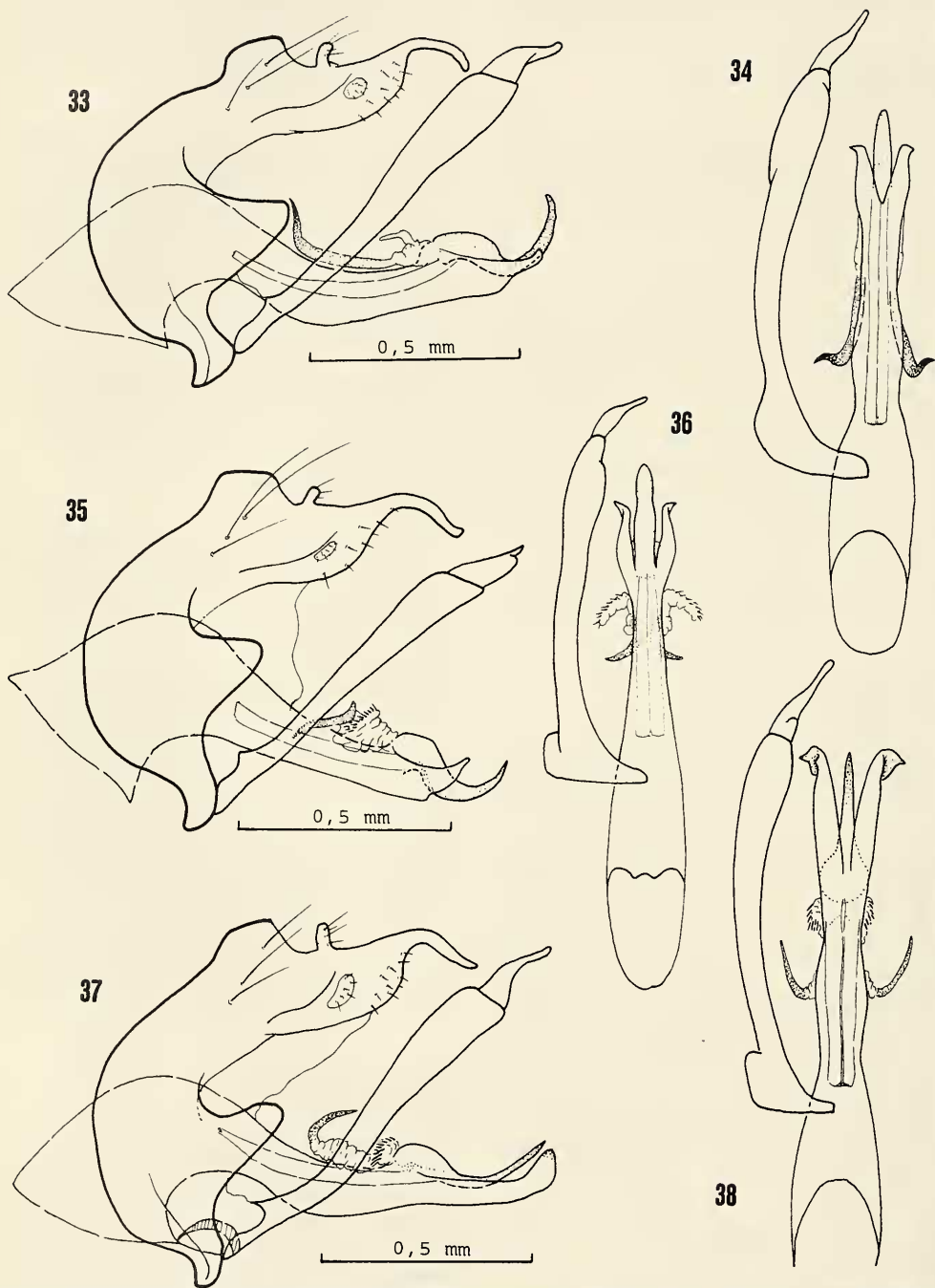
Description. – External characters as in *H. germanorum* sp. n. Length of forewing 9 mm.

Male genitalia (figs. 26-27): Apical appendages of segment 10 bent downwards. Second segment of inferior appendages simple, with an acute tip. Phallotremal tongue longer than the lateral sides of phalothecal tip, which are characteristically curved upwards. Dorsolateral membrane with 3 pairs of appendages, the longer with a long spur apically, the two shorter ones with minute spines.

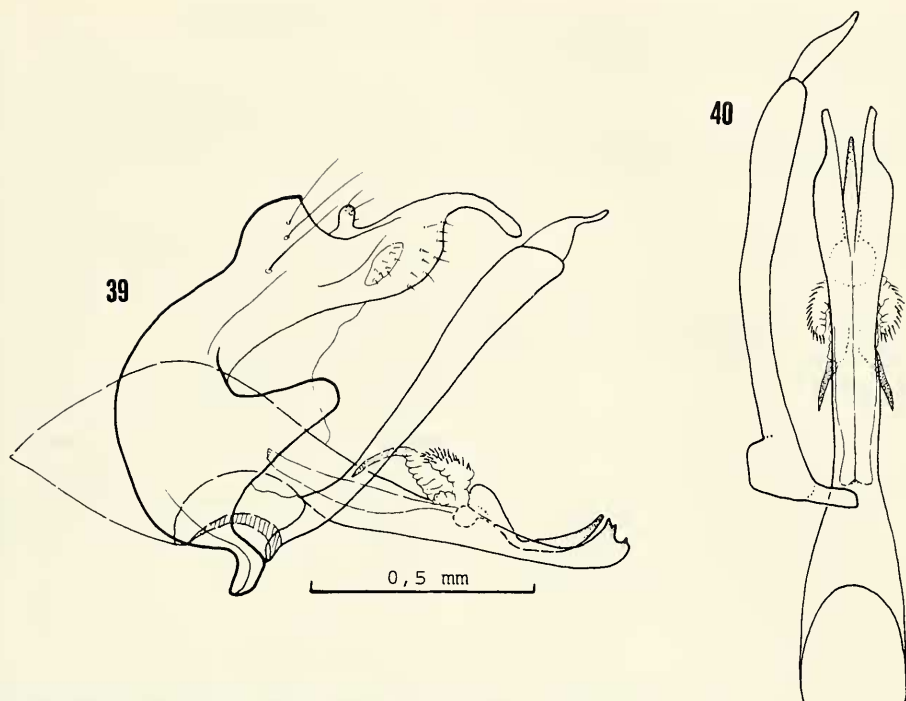
Remarks. – The nearest relative is obviously *H. hamifera* from the same island. In comparison with the figures of the type of *H. hamifera* in Neboiss (1996: 7) the species differs in the structure of the phalotheca.

***Hydropsyche salki* sp. n.**  
(figs. 28-30)

Type material. – Holotype ♂ (in alcohol), Indonesia, Seram, Piljana, 25.2.1994, leg. P. Salk, in MNHB. – Paratypes: 2 ♀, same data as holotype; 3 ♂, Indonesia, Sulawesi Selatan, Puncak, 1000m, 22.ii.1994, leg. P. Salk; 47 ♂, 3 ♀, Indonesia, Bacan Island, Mt. Sibela, 5-8.ii.1996, leg. V. Siniaev (2 ♂ in coll. Malicky); 3 ♂, 3 ♀, Indonesia, Halmahera, Mt. Talagaramu, 15 km SE Baru, 600m, 22-31.i.1996, leg. V. Siniaev.



Figs. 33-38. Male genitalia of *Hydropsyche* spp. – 33-34, *H. suppleta* sp. n., 33, lateral, 34, ventral; 35-36, *H. naumanni* sp. n., 35, lateral, 36, ventral; 37-38, *H. sulana* sp. n., 37, lateral, 38, ventral.



Figs. 39-40. Male genitalia of *Hydropsyche bacanensis* sp. n. — 39, lateral, 40, ventral.

Description. — External characters as in *H. germanorum* sp. n. Length of forewing 8-10 mm.

Male genitalia (figs. 28-30): Segment 9 with a distinct carina. Dorsal processes of segment 10 very small or lacking. Apical segment of inferior appendages sinuate. Phallotremal tongue broad, with a bifid tip. Dorsolateral membrane with one pair of long appendages, apically armed with minute spines.

Etymology. — The species is dedicated to Peter Salk, who collected this species during his voyage in Indonesia and donated the material to the MNHB.

Remarks. — The species is related to *H. sirimauna* sp. n. The dorsolateral appendages of the phallotrocha and the second joint of the inferior appendages are differently shaped.

***Hydropsyche sirimauna* sp. n.**  
(figs. 31-32)

Type material. — Holotype ♂ (in alcohol), Indonesia, Ambon, Gunung Sirimau, 500m, 23.vii.1995, leg. S. Naumann, in MNHB. — Paratypes: 5♂, Indonesia, Seram, Piljana, 600m, 26.ii.1994, leg. P. Salk.

Description. — External characters as in *H. germanorum* sp. n. Length of forewing 7.5 mm.

Male genitalia (figs. 31-31): Dorsal processes on segment 10 lacking. Apical segment of inferior appendages sinuate in lateral view. Phallotrocha slightly bent upwards. Phallotremal tongue strongly sclerotized, as long as the phallotrocha. Dorsolateral membrane with a pair of very long appendages, ending with a sclerotized and serrate tip.

Remarks. — *H. sirimauna* sp. n. is related with the preceding species. Both occur sympatrically on Seram.

***Hydropsyche suppleta* sp. n.**  
(figs. 33-34)

Type material. — Holotype ♂ (in alcohol), Indonesia, Ambon, Katalai, 470m, 26.vii.1995, leg. S. Naumann, in MNHB. — Paratypes: 1♂, same data as holotype; 2♂, Indonesia, Ambon, 200m, 24.ii.1994, leg. P. Salk; 1♂, Indonesia, Seram, Piljana, Tule, 600m, 26.2.1994, leg. P. Salk.

Description. — External characters as in *H. germanorum* sp. n. Length of forewing 8 mm.

Male genitalia (figs. 33-34): Segment 10 with both dorsal and apical appendages. Phallotrocha slightly sinuate. Freely protruding apicolateral sides of phal-

lothea reduced. Phallotremal sclerites large, as long as its tongue. Dorsolateral membrane with two short lobes, the lateral one with a long and distinctively bent spine.

Remarks. – The new species is a close relative of *H. naumanni* sp. n. from Sulawesi. They differ in the structure of the dorsolateral appendages.

***Hydropsyche naumanni* sp. n.**  
(figs. 35–36)

Type material. – Holotype ♂ (in alcohol), Indonesia, Sulawesi Tengah, Taripa, 700m, 26.8.1995, leg. S. Naumann, in MNHB. – Paratypes: 2♂, same data as holotype.

Description. – External characters as in *H. germanorum* sp. n. Length of forewing 8 mm.

Male genitalia (figs. 35–36): Segment 10 with both dorsal and apical appendages. Phallotheca straight. Freely protruding apicolateral sides of phallotheca reduced, directed dorsally. Phallotremal sclerites large. Dorsolateral membrane with two pairs of appendages, the longer with a bent spur, the smaller with minute spines on the tips.

Etymology. – The species is named in honour of Stefan Naumann, specialist on Emperor Moths (Lepidoptera, Saturniidae), who collected the species on Sulawesi and donated the material to the MNHB.

Remarks. – The species is closely related to *H. suppleta* sp. n. from Seram and Ambon. Both species can be separated easily by the different structure of the phallic apparatus.

***Hydropsyche sulana* sp. n.**  
(figs. 37–38)

Type material. – Holotype ♂ (in alcohol), Indonesia, Moluccas, Sula Islands, Sanana, 1 km W Wai-bau, 250m, 3.viii.1995, leg. S. Naumann, in MNHB. – Paratypes: 5♂, 2♀, same data as holotype.

Description. – External characters as in *H. germanorum* sp. n. Length of forewing 8–9 mm.

Male genitalia (figs. 37–38): Segment 10 with dorsal and apical appendages. Second segment of inferior appendages short and slender. Phallotheca slightly sinuate, apicolateral parts enlarged and bent outwardly. Phallotremal tongue reaching just the tip of the phallotheca. Dorsolateral membrane with two pairs of appendages, the longer with a terminal spur, the shorter covered with minute spines.

Remarks. – The new species is related to the next species, *H. bacanensis* sp. n.

***Hydropsyche bacanensis* sp. n.**  
(figs. 39–40)

Type material. – Holotype ♂ (in alcohol), Indonesia, Moluccas, Bacan, Mt. Sibela, 2.–13.ii.1996, leg. V. Siniaev, in MNHB. – Paratypes: 2♂, same data as holotype.

Description. – External characters as in *H. germanorum* sp. n. Length of forewing 8.2 mm.

Male genitalia (figs. 39–40): Segment 9 with a well developed carina. Second segment of inferior appendages with broad base and slender apical half. Phallotheca with elongated apical parts, broad and serrate dorsally. Phallotremal tongue not reaching tip of phallotheca. Dorsolateral membrane with two pairs of appendages, the slightly longer with a terminal spur and the shorter with minute spines.

Remarks. – *H. bacanensis* sp. n. is a close relative to the preceding species, *H. sulana* sp. n. The morphological differences in the phallic apparatus are minor, but constantly expressed.

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REFERENCES

- Banks, N., 1930. Some neuropteroid insects from North Borneo, particularly from Mt. Kinabalu. – *Journal of the FMS Museums* 14: 411–429.
- Banks, N., 1937. Philippine neuropteroid insects. – *The Philippine Journal of Science* 63: 125–174.
- Banks, N., 1939. New genera and species of neuropteroid insects. – *Bulletin of the Museum of comparative Zoology* 85 (7): 439–504.
- Bueno-Soria, J., 1984. Description of the larva and pupa of *Mexipsyche toschiae* (Denning) (Trichoptera: Hydropsychidae). – In: J. C. Morse (ed.), *Proceedings of the 4th International Symposium on Trichoptera*, Clemson 1983: 49–55. – Junk Publishers, The Hague.
- Flint, O. S. & J. Bueno-Soria, 1987. Studies of Neotropical caddisflies, XXXVI: The genus *Calosopsyche* in Central America, with descriptions of its immature stages (Trichoptera: Hydropsychidae). – In: M. Bournaud & H. Tachet (eds.), *Proceedings of the 5th International Symposium on Trichoptera*, Lyon 1986: 29–37. – Junk Publishers, Dordrecht.
- Kimmins, D. E., 1955. Results of the Oxford University Expedition to Sarawak, 1932. Order Trichoptera. – *Sarawak Museum Journal* 6 (5): 374–442.

- Kimmins, D. E., 1957. Neuroptera and Trichoptera collected by Mr. J. D. Bradley on Guadalcanal Islands 1953-1954. – Bulletin of the British Museum (Natural History), Entomology series 5: 289-308.
- Kimmins, D. E., 1962. Miss L.E. Cheesman's expeditions to New Guinea. – Bulletin of the British Museum (Natural History), Entomology series 11 (4): 99-187.
- Korboot, K., 1964. Eight new species of caddisflies from the Australian Region. – University of Queensland Papers, Department of Entomology 2 (2): 47-56.
- Malicky, H., 1977. Ein Beitrag zur Kenntnis der *Hydropsyche guttata*-Gruppe. – Zeitschrift der Arbeitsgemeinschaft österreichischer Entomologen 29: 1-28.
- Malicky, H., 1996. Neue Köcherfliegen aus Thailand (Trichoptera). – Entomologische Berichte Luzern 36: 119-128.
- McFarlane, A. G., 1976. A generic revision of New Zealand Hydropsychinae (Trichoptera). – Journal of the Royal Society of New Zealand 6: 23-35.
- Mey, W., 1990. Neue und wenig bekannte Arten der Gattung *Hydropsyche* Pictet von den Philippinen (Trichoptera, Hydropsychidae). – Deutsche entomologische Zeitschrift, Neue Folge 37 (4): 413-424.
- Mey, W., 1995. Beitrag zur Kenntnis der Köcherfliegenfauna der Philippinen. I. (Trichoptera). – Deutsche entomologische Zeitschrift, Neue Folge 42 (1): 191-209.
- Mey, W., 1996. Zur Kenntnis der *Hydropsyche pluvialis*-Gruppe in Südostasien (Trichoptera: Hydropsychidae). – Entomologische Zeitschrift 106 (4): 144-152.
- Mey, W., 1998. Contribution to the knowledge of the caddisflies of the Philippines. 2. The species of the Mt. Agtuaganon Range on Mindanao (Insecta: Trichoptera). – Nachrichten des entomologischen Vereins Apollo, Suppl. 17: (in press).
- Mey, W., 1998. The *Hydropsyche formosana* group in the Oriental region: taxonomy, distribution and phylogeny. – Proceedings of the 9th International Symposium on Trichoptera, Chiang Mai 1998 (in preparation).
- Mosely, M. E., 1951. Descriptions of new Sarawak Trichoptera. – The Annals and Magazine of Natural History (12) 4: 480-490.
- Navás, R. P. L., 1925. Insectos exóticos nuevos o poco conocidos. – Memorias de la Real Academia de Ciencias y Artes de Barcelona 19 (5): 180-200.
- Navás, R. P. L., 1927. Veinticinco formas nuevas de insectos. – Boletín de Sociedad Ibérica de Ciencias Naturales 26: 48-75.
- Neboiss, A., 1986. Atlas of Trichoptera of the SW Pacific-Australian Region. – Junk Publishers, The Hague, 286 pp.
- Neboiss, A., 1996. Notes and illustrations of some *Hydropsyche* and *Hydromanicus* types (Hydropsychidae). – Braueria (Lunz am See) 23: 7-9.
- Nielsen, A., 1981. On the evolution of the phallus and other male terminalia in the Hydropsychidae with a proposal for a new generic name. – In: G. P. Moretti (ed.), Proceedings of the 3rd International Symposium on Trichoptera, Perugia 1980: 273-278. – Junk Publishers, The Hague.
- Nimmo, A. P., 1987. The adult Arctopsychidae and Hydropsychidae (Trichoptera) of Canada and adjacent United States. – Quaestiones Entomologicae 23: 1-189.
- Pictet, F. J., 1834. Recherches pour servir à l'Histoire et à l'Anatomie des Phryganides. – Genève, III + 235 pp.
- Ross, H. H., 1944. The caddisflies, or Trichoptera, of Illinois. – Bulletin of the Illinois Natural History Survey 23: 1-326.
- Ross, H. H. & J. D. Unzicker, 1977. The relationships of the genera of American Hydropsychinae as indicated by phallic structures (Trichoptera; Hydropsychidae). – Journal of the Georgia Entomological Society 12 (4): 298-312.
- Scheffer, P. W., 1996. Phylogenetic relationships among subfamily groups in the Hydropsychidae (Trichoptera) with diagnoses of the Smicrideinae, new status, and the Hydropsychinae. – Journal of the North American benthological Society 15 (4): 615-633.
- Scheffer, P. W. & G. B. Wiggins, 1986. A systematic study of the Nearctic larvae of the *Hydropsyche morosa* Group (Trichoptera: Hydropsychidae). – Life sciences miscellaneous publications, Toronto, 94 pp.
- Scheffer, P. W., Wiggins, G. B. & J. D. Unzicker, 1986. A proposal for assignment of *Ceratopsyche* as a subgenus of *Hydropsyche*, with new synonyms and a new species (Trichoptera: Hydropsychidae). – Journal of the North American benthological Society 5: 67-84.
- Schmid, F., 1965. Quelques Trichoptères de Chine II. – Bonner zoologische Beiträge 16: 127-154.
- Schmid, F., 1979. On some new trends in Trichopterology. – Bulletin of the entomological Society of Canada 11: 48-57.
- Schuster, G. A., 1984. *Hydropsyche*? – *Symphitopsyche*? – *Ceratopsyche*? A taxonomic enigma. – In: J. C. Morse (ed.), Proceedings of the 4th International Symposium on Trichoptera, Clemons 1983: 339-345. – Junk Publishers, The Hague.
- Tanida, K., 1986. A revision of Japanese species of the genus *Hydropsyche* (Trichoptera, Hydropsychidae) I. – Kontyû, Tokyo 54 (3): 467-484.
- Tian, L. X. & Y. W. Li, 1987. A preliminary study of the subfamily Hydropsychinae (Trichoptera: Hydropsychidae) in China. – In: M. Bournaud & H. Tachet (eds.), Proceedings of the 5th International Symposium on Trichoptera, Lyon 1986: 125-129. – Junk Publishers, The Hague.
- Ulmer, G., 1905. Zur Kenntnis aussereuropäischer Trichopteren. – Stettiner entomologische Zeitschrift 1905: 3-119.
- Ulmer, G., 1911. Die von Herrn Hans Sauter auf Formosa gesammelten Trichopteren (Neur.). – Deutsche entomologische Zeitschrift 1911: 396-401.
- Ulmer, G., 1915. Trichopteren des Ostens, besonders von Ceylon und Neu-Guinea. – Deutsche entomologische Zeitschrift 1915: 41-75.
- Ulmer, G., 1930. Trichopteren von den Philippinen und von den Sunda-Inseln. – Treubia 11: 373-498.
- Ulmer, G., 1951. Köcherfliegen (Trichopteren) von den Sunda-Inseln (Teil I). – Archiv für Hydrobiologie, Supplement 19: 1-528.

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